

[54] PACKAGING MACHINE AND METHOD

3,592,049 7/1971 Johanski 53/53 X

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[57] **ABSTRACT**

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53/112 A, 73/49.3

[51] Int. Cl. **B65b 31/02, B65b 57/02**

[58] Field of Search **53/22, 53, 78, 112;**
73/49.3

A machine and method for packaging cheese are disclosed as including apparatus having a four unit die for enabling the vacuum packaging of four cheese packages at any one time. The packages are formed by top and bottom plastic webs which are first partially sealed, then evacuated, then finally sealed, partially cut, examined for leaks, and then fully cut and separated to eliminate defective packages. The examination for leaks is accomplished by a novel leak detection system including apparatus for sensing package leaks after final seal has been accomplished.

[56] **References Cited**

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4 Claims, 15 Drawing Figures

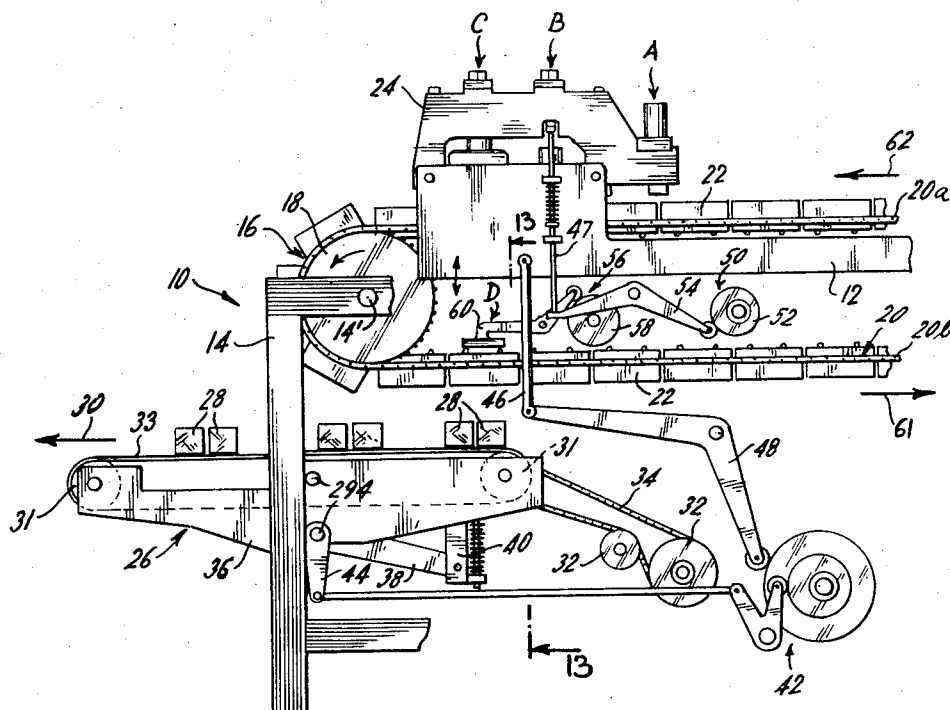


FIG. 1.

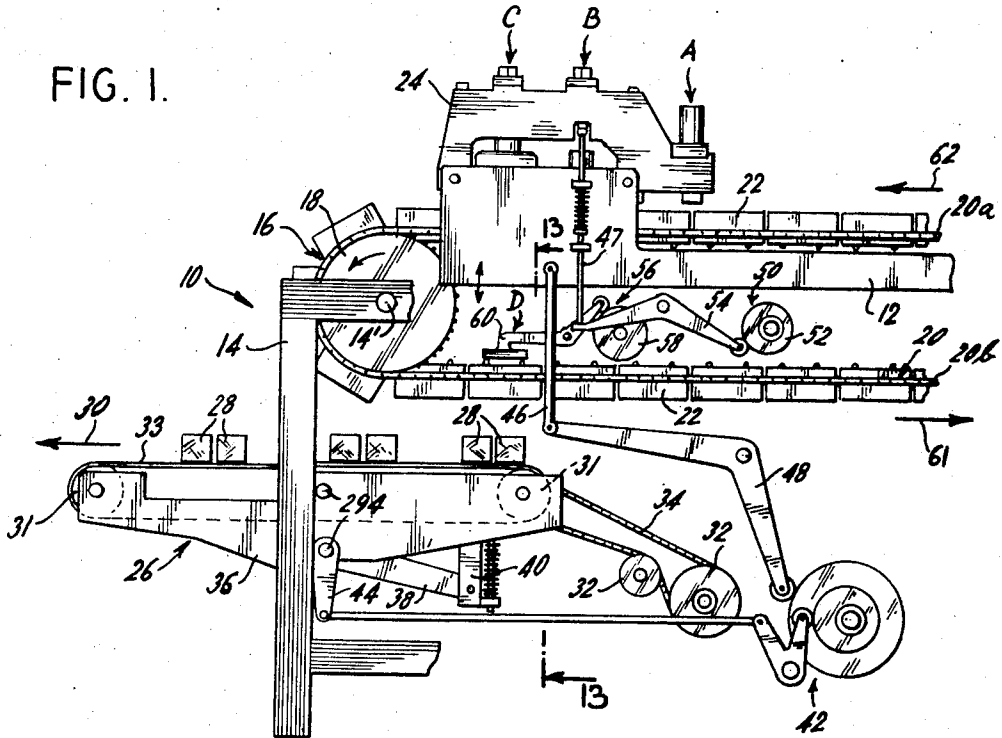
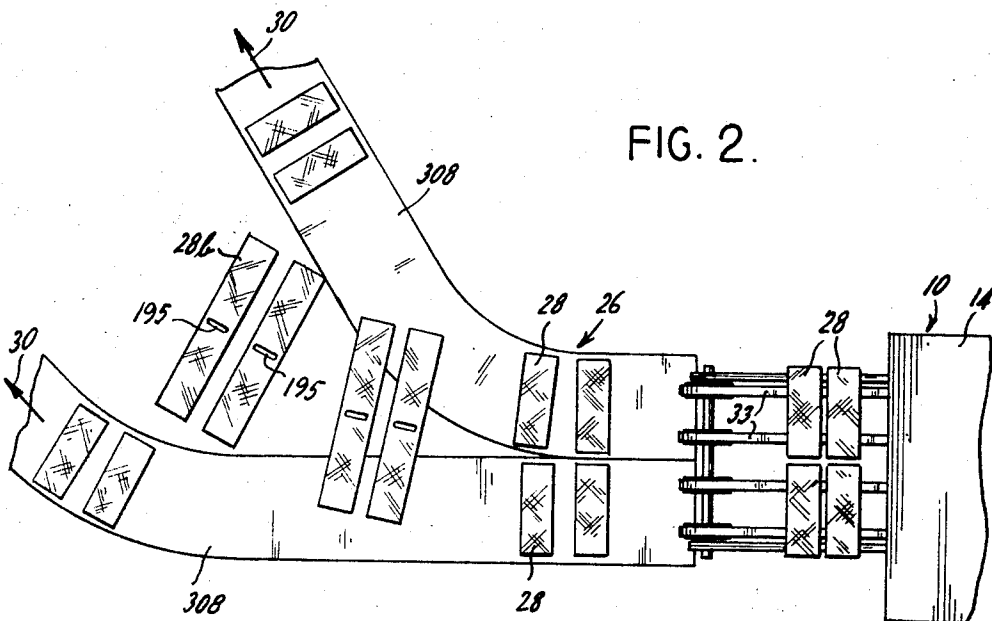
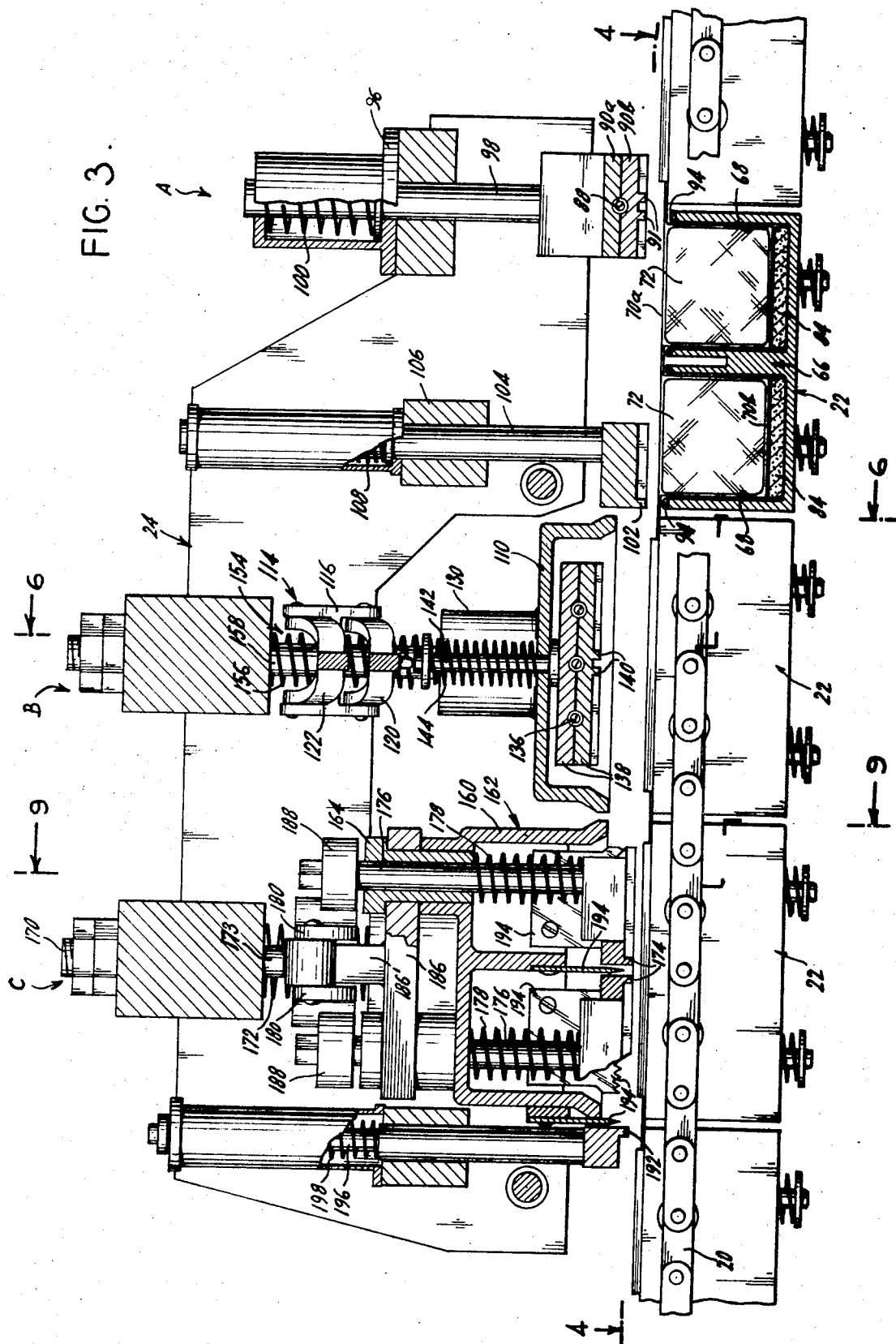


FIG. 2.



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FIG. 3.



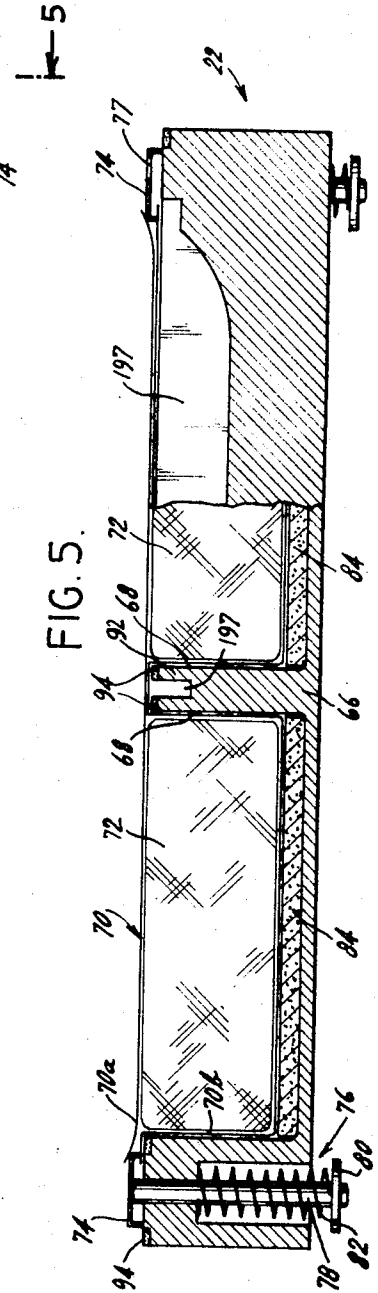
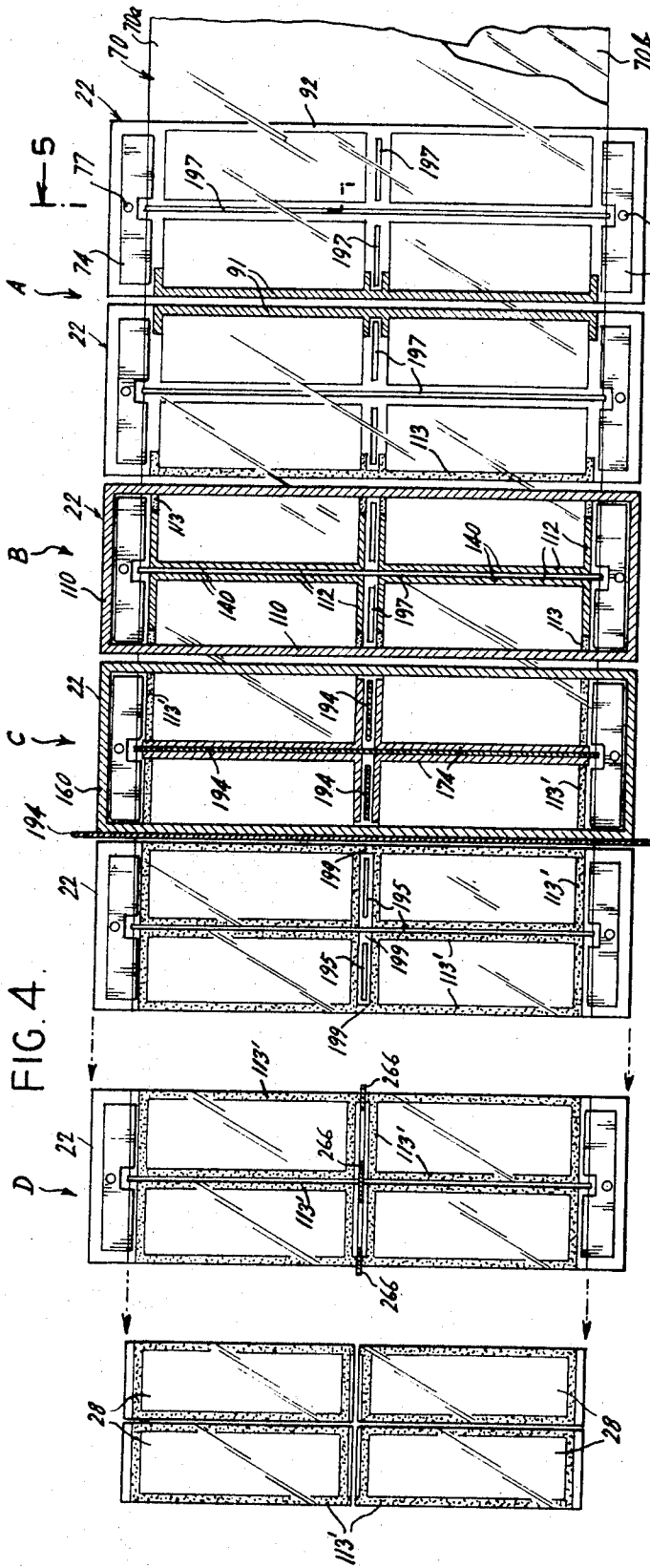


FIG. 6.

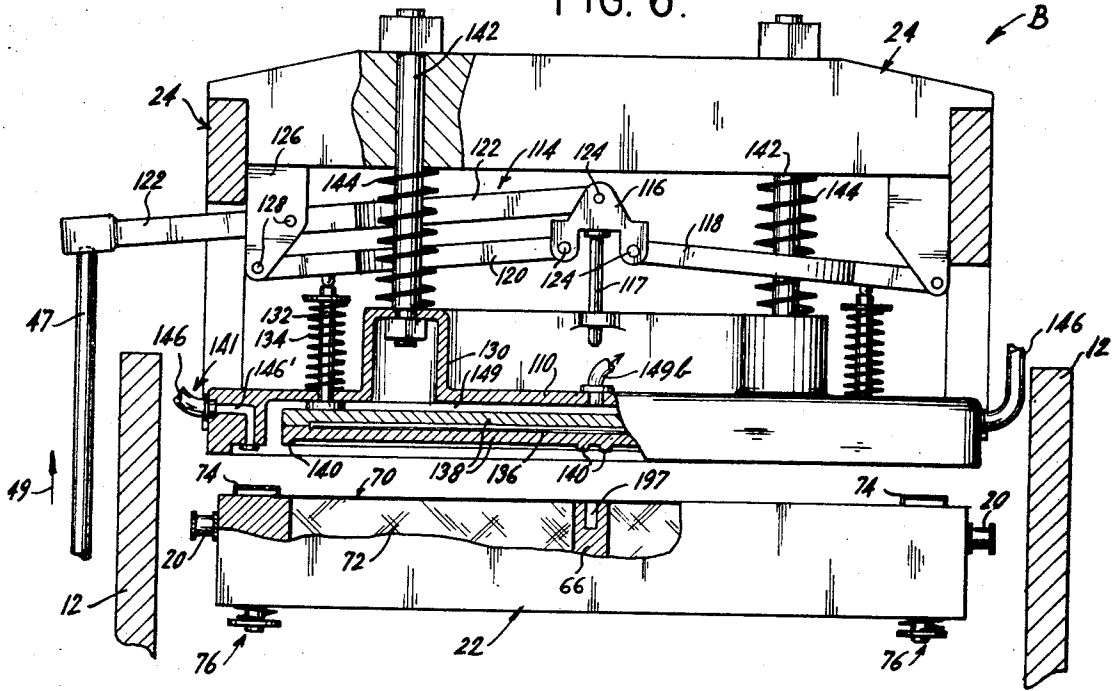


FIG. 8.

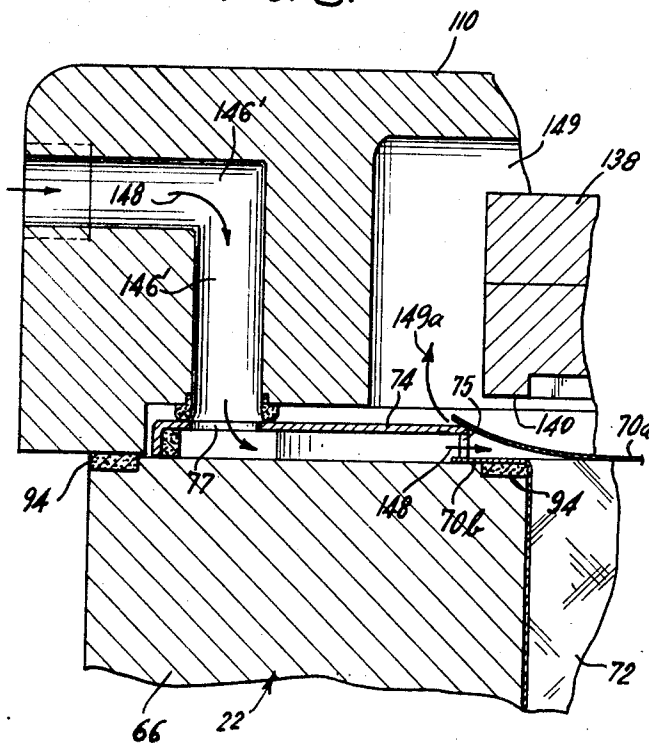


FIG. 7.

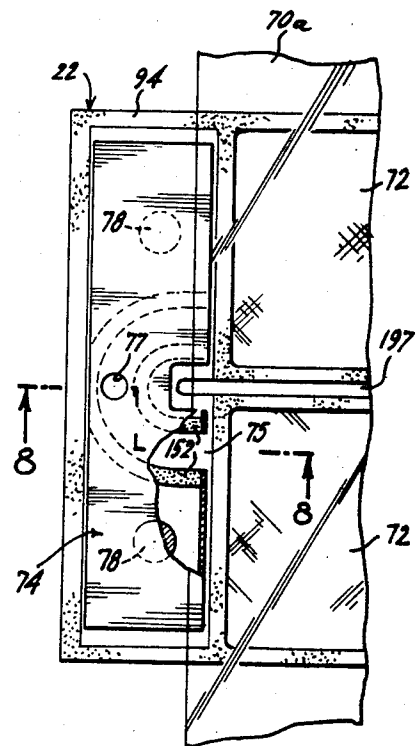


FIG. 11.

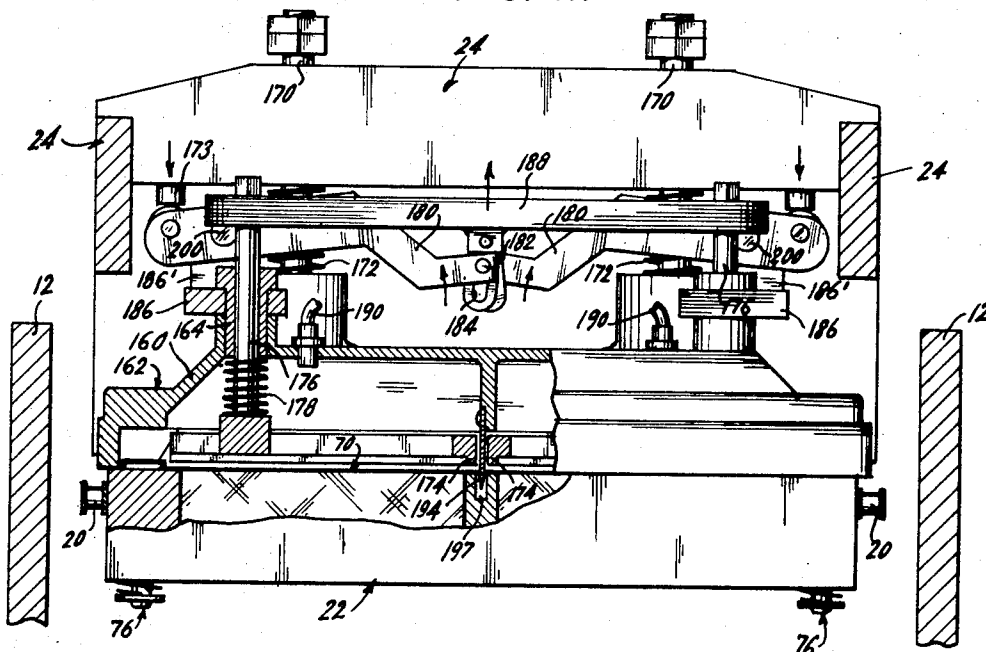
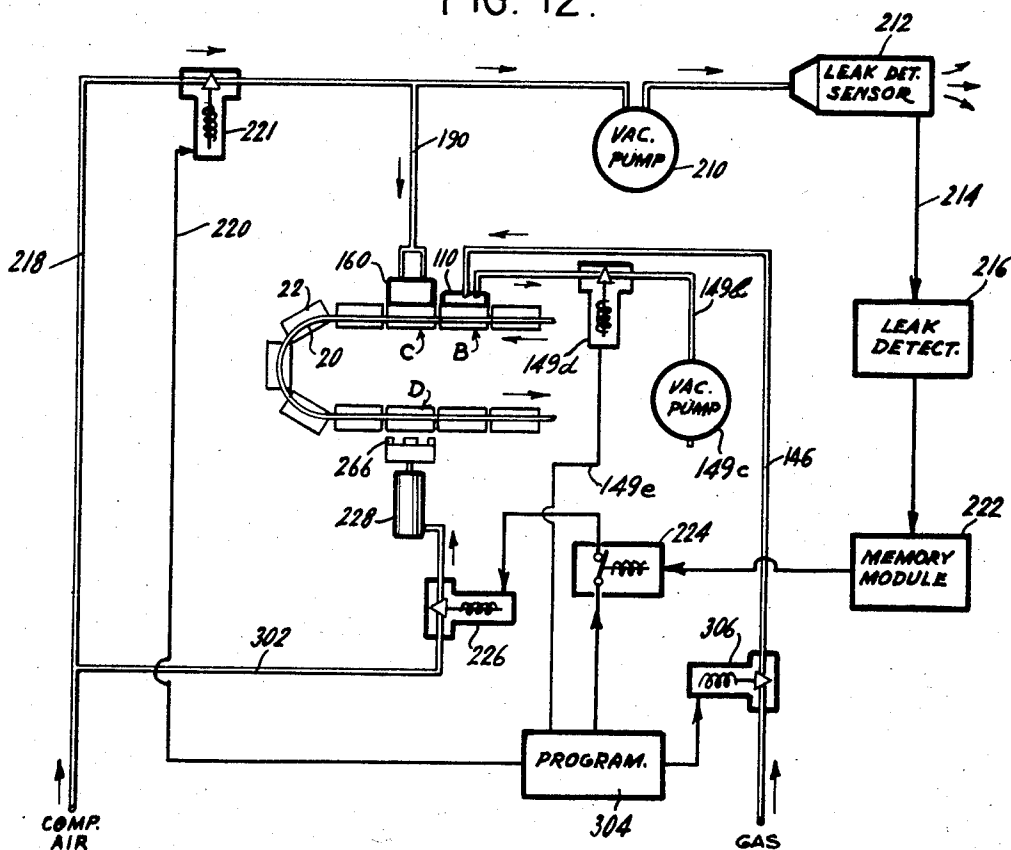


FIG. 12.



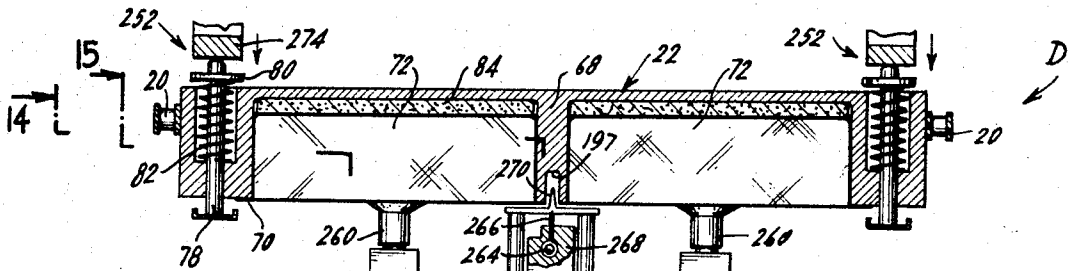


FIG. 13.

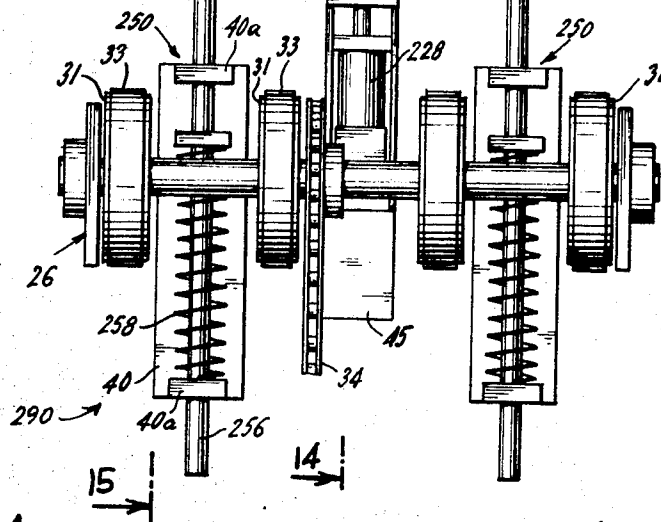
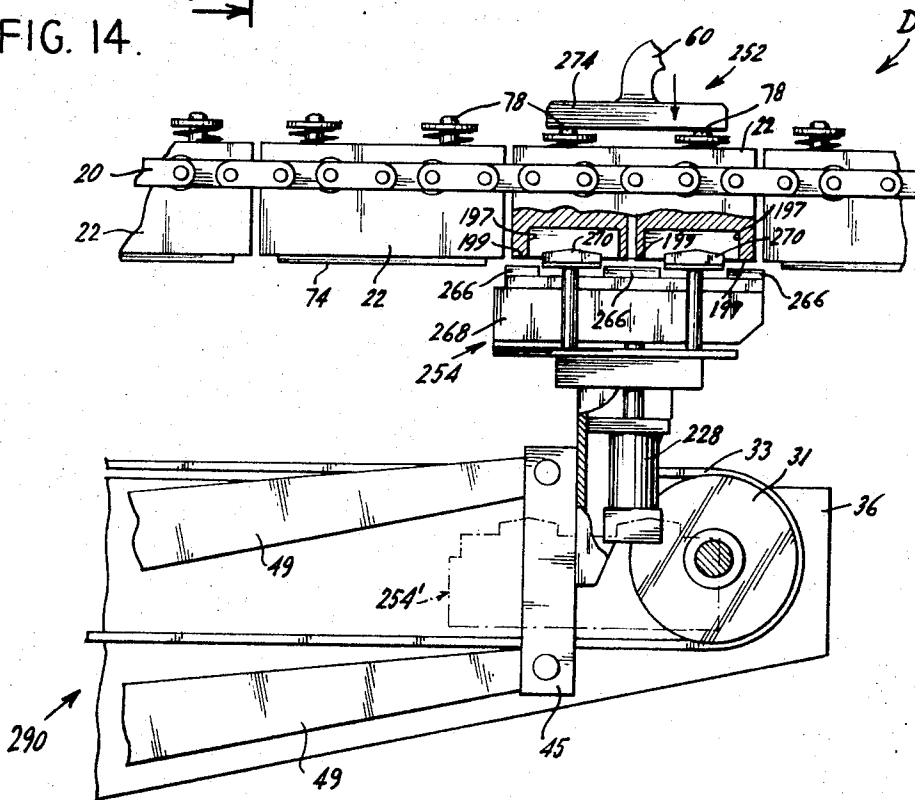
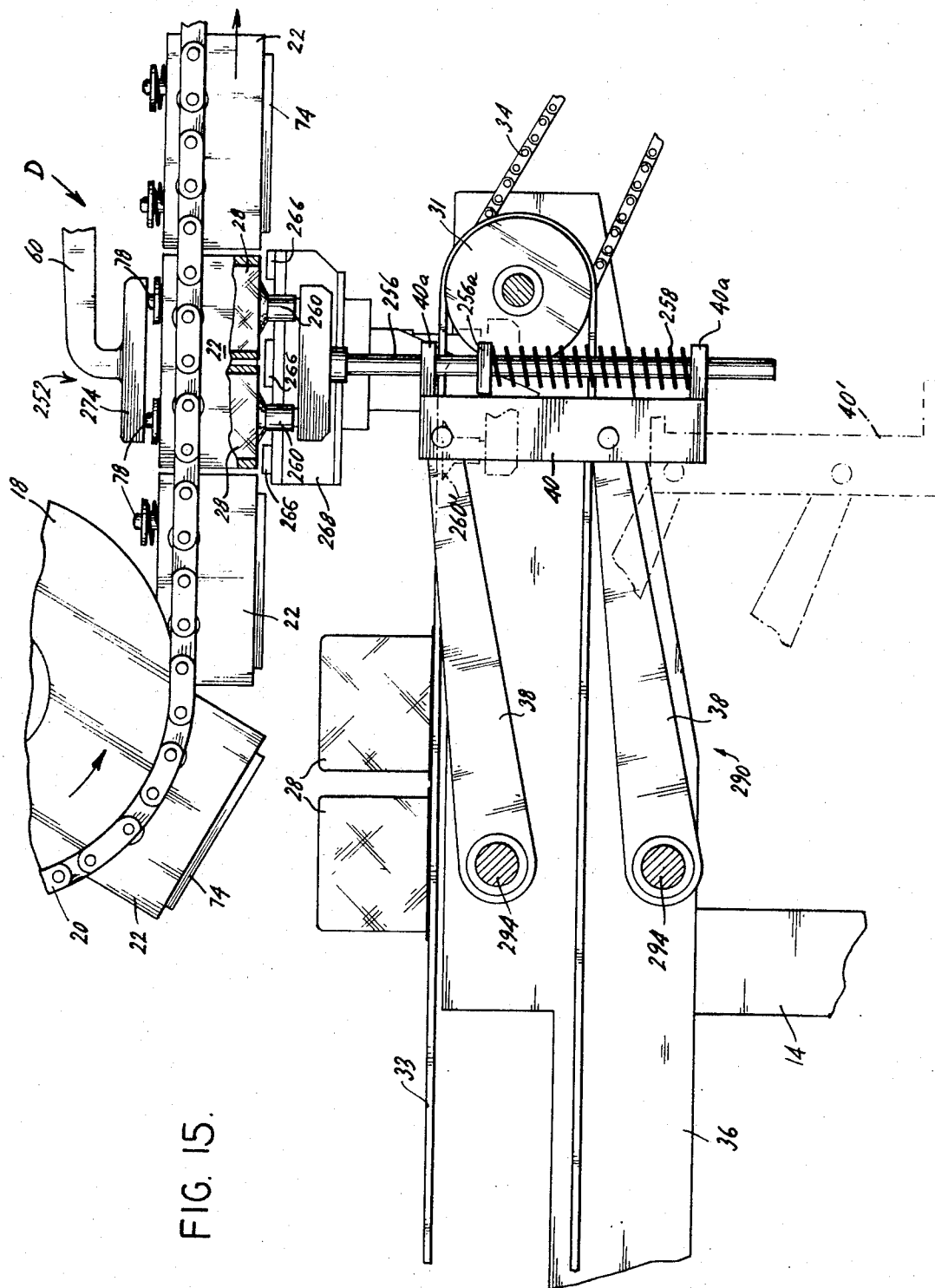


FIG. 14.





PACKAGING MACHINE AND METHOD

This invention relates primarily to processing machines and methods and more particularly to such machines and methods applicable to perishable products and the like.

A multitude of prior art machines and methods have been devised for automatically packaging products including those which form packages from heat-sealable flexible packaging material. Such packages have found wide acceptance in the food packaging field because of the extended shelf life afforded to the packaged product by use of such materials. For instance, meats, cheeses, nuts and dried fruits have particularly benefited from such packaging in that these food products must be protected from oxidizing influences such as atmospheric oxygen and must be vacuum sealed for preservation purposes.

Prior art apparatus has included means for conveying a plurality of packages, for example packages of cheese, through various operation stations. For instance, a first station includes means for forming two cheese packages at any one time, the packages having top and bottom heat sealable web members conveyed along with the packages through various operation stations. A second station includes means for sealing the top and bottom webs and the next station includes means for cutting and separating the formed packages. Various leak detection systems have been employed with such prior art systems, but apparatus for such detection is usually separate from the general packaging apparatus. Such detection apparatus has also required an input of only individual packages which dictates the timing and placement of the separating mechanism for the individual packages in the packaging machine. Also, when a defective package is sensed by such prior art mechanisms, hand-sorting techniques are commonly used to separate the good packages from the bad.

Accordingly, a primary object of the present invention is to provide a fully automatic, continuous packaging, evacuating, leak detection and sorting apparatus and method to overcome the difficulties experienced with prior art apparatus and methods.

A further and more particular object of the present invention is to provide a continuous packaging apparatus and method that includes means for handling four packages at any one operational station of the apparatus.

A still further object is to provide an apparatus and method useful in the packaging of perishable foodstuff and the like which includes a novel leak detection system, which automatically, during the packaging process, detects defective packages and programs the separation thereof from the packages without defects.

These and other objects of the present invention are accomplished in one illustrative embodiment thereof which features an apparatus and method for forming packages. Heat-sealable flexible packaging webs are moved over a die, to form a plurality of attached receptacles for receiving the product to be packaged. The bottom web is formed into a bottom wall for such receptacles by a bottom vacuum with a top air pressure assist. The food product is then loaded into the receptacles and covered by an unformed top web, after which the receptacle is partially sealed. The foregoing method is performed at a first machine station according to the

present invention and four product receptacles are thereby provided.

The receptacles or packages are then moved along to a second station wherein the packages are evacuated, carbon dioxide and a freon tracer are introduced to the receptacle and a final seal of the top web to the bottom web is accomplished to seal the packages. Thus, the second station in the apparatus and method of the present invention provides an evacuated product chamber and the introduction of a leak detection tracer prior to final sealing of the product receptacle.

Strippers and knives then accomplish partial separation of packages in preparation for a leak detection step at a third station, and apparatus is provided for detecting any escape of the tracer introduced to the packages.

A final station accomplishes severance into four individual packages; however, such final separation is eliminated upon a signal from the leak detection system that a particular package is defective. This final station of the apparatus is capable of conveying, for further processing, only individual packages and tandem packages are thereby separated from the non-defective individual packages. Simultaneously with such separation of defective from non-defective packages, a suction system operates to deposit all packages and then convey only the individual non-defective packages for further processing.

The above brief description as well as further objects, features and advantages of the present invention will be more fully appreciated by reference to the following detailed description of the preferred, but nonetheless illustrative embodiment when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is an elevational view of the system apparatus according to the present invention showing particularly the conveyor system, the sealing, cutting and leak detection head and the product separation apparatus thereof;

FIG. 2 is a top plan view of the product separation apparatus and conveyor system;

FIG. 3 is a longitudinal sectional view of the sealing, cutting and leak detection head useful in the apparatus according to the present invention and a partial view of the package conveyor system therefor;

FIG. 4 is a top plan view of packages in process (the process being linearly presented for clarity) showing particularly the conditions thereof at various stages in the apparatus of the present invention;

FIG. 5 is a transverse section, taken along the line 5—5 of FIG. 4 and showing particularly the formation of packages by the use of top and bottom webs according to the present invention as well as the construction of the four unit dies useful in such formation;

FIG. 6 is a sectional view taken along the line 6—6 of FIG. 3 and showing particularly the construction of apparatus useful in evacuation, tracer filling and final hot sealing of packages at a second station of packaging apparatus according to the present invention;

FIG. 7 is a partial plan view of the package and package web side clamp construction useful during the operation performed by the apparatus of FIG. 6;

FIG. 8 is a sectional view taken along the line 8—8 of FIG. 7 and showing particularly the evacuation and carbon dioxide and freon introducing apparatus useful in the operations performed by the apparatus of FIG. 6 according to the present invention;

FIG. 9 is a sectional view taken along the line 9—9 of FIG. 3 and showing particularly the leak detection and partial cutting apparatus station according to the present invention;

FIG. 10 depicts the apparatus of FIG. 9, during the partial cutting operation and with a vacuum chamber formed for leak detection;

FIG. 11 is a further view of the apparatus of FIG. 9 showing particularly the final leak detection operation wherein the package is completely exposed to better enable leak detection of the entire package surface;

FIG. 12 is a schematic representation of an entire system according to the present invention showing particularly the leak detection system, the defective package separation system and the interconnection therebetween;

FIG. 13 is a sectional view taken along the line 13—13 of FIG. 1 and showing particularly the final cutting apparatus along with the defective product separation construction and apparatus;

FIG. 14 is a sectional view taken along the line 14—14 of FIG. 13 and showing particularly the final cutting apparatus according to the present invention;

FIG. 15 is a sectional view taken along the line 15—15 of FIG. 13 and showing a further view of the apparatus for separation of packages to enable further processing according to the present invention.

Referring to the drawings, and in particular to FIG. 1 thereof, an apparatus according to the present invention hereof is shown as including a machine, generally designated 10, having a machine frame 14 and a movable head frame 12. A conveyor system, generally designated 16, is rotatably attached to the machine frame 14 by a shaft 14' and appropriate bearings and the like. Conveyor system 16 includes sprocket 18 and conveyor member 20 in the form of a linked chain or the like. Conveyor member 20 is arranged to move about sprocket 18 such that it forms an upper run 20a and a lower run 20b and carries a plurality of die members 22 as will be more fully described hereinafter.

Attached to movable head frame 12 is a machine head 24 defining machine stations A,B,C, the function of which will be apparent by a subsequent detailed description herein of an apparatus and method according to a preferred embodiment of the present invention.

Furthermore, the lower run 20b of the conveyor system defines a machine station D, whose function it is to release all packages processed in the upper run and to selectively cut and separate such packages for further processing. Such further processing is accomplished on a belt system or the like, generally designated 26 wherein individual packages 28 are conveyed in direction 30 for boxing or other further processing. The belt system 26 includes belt rollers 31, about which belts 33 move and sprockets 32, about which line chain 34 moves. Belt system 26 is carried on a frame member 36 to which is pivotally attached a removal mechanism as will hereinafter be explained in detail. The removal mechanism includes arms 38 and arm uprights 40, whose motion is as dictated by cam system 42 and links 44. Cam system 42 also provides control for the motion of movable head frame 12 by means of link 46 and cam follower 48.

A second cam system 50, including cam 52 and cam follower 54 controls the motion of a part of the mechanism of station B as will hereinafter be explained and a third cam system 56, including cam 58 and cam fol-

lower 60 controls the mechanism at station D of the apparatus herein. Thus, by way of general description, perishable items such as cheeses are processed by the apparatus of the present invention by deposit in die members 22 and conveyance of such die members 22 in direction 62 in the upper run 20a of a conveyor system, such that the die members pass head 24 for processing. Such processing includes the formation of a package; initial sealing at station A; evacuation, the introduction of a leak tracer and final sealing at station B; partial cutting and evacuation for leak detection at station C and conveyance to the lower run 20b of the conveyor system. On the lower run of the conveyor system, at station D, the packages 28 are moved in direction 61 where final cutting is accomplished for all packages where no leaks have been detected and all packages are released from conveyor system 16 to belt system 26.

Referring now to FIGS. 3 through 11 (with some reference to FIG. 12), the mechanism of head 24 will now be described in detail. In order to set the background for such a description, reference will first be made to FIGS. 4 and 5 in order to describe the initial formation of packages 28 for processing by the mechanism of head 24.

Die member 22 includes main body member 66 defining die cavities 68. Four such die cavities 68 are provided according to the present invention herein such that four cheese packages are processed at any one time in any one of the operational stations A,B,C,D in the apparatus of the packaging machine. Furthermore, it is to be understood that all operations of the apparatus of the present invention take place simultaneously, so that while one set of four cheese packages is undergoing processing at one station, another set of four cheese packages is undergoing other processing in another station.

A web, generally designated 70, is conveyed onto die member 22, the web including top and bottom web members 70a, 70b, respectively. Bottom web member 70b is preformed into a package bottom by simultaneous bottom suction and top pressure so that it conforms to the die cavity 68 in die member 22. Thereafter, a batch loader or the like (not shown) by means well known in the art, deposits cheese 72 onto package bottoms formed by bottom web member 70b. Top web member 70a is then conveyed (by means well known in the art) to cover cheese 72 and thereby form a total package for processing by an apparatus and method according to the present invention.

The die members 22 include side clamps 74 on the top wall thereof for clamping bottom web member 70b during upper and lower run conveyance. Such side clamps 74 are associated with side clamp release mechanisms 76 including release shafts 78, heads 80, and springs 82. The operation of side clamp release mechanism 76 will be described more fully with reference to operational station D of the present apparatus. It should also be mentioned that according to the particular size of the cheese 72 deposited onto bottom web member 70b, a cavity filler 84 (FIG. 5) may be included at the bottom of die cavity 68 such that the bottom web member 70b rests thereon during the various processing steps.

Now referring to FIGS. 3, 4 and 5, the head 24 and operations for stations A, B, and C will be described. At station A, the mechanism of the machine head 24 of

the present invention provides an initial seal 113 for the cheese package defined by web members 70a and 70b. Initial seal 113 is accomplished by the the head mechanism including appropriately powered heating elements 88 and heat transfer members 90a, 90b. The lower part of one of the heat transfer members 90b defines heating surfaces 91 for mating with the upper surface of preseal die members 92 of cavity 68. Rubber gasket 94 is disposed at the top of preseal die members 92 in order to effectively seal the cavities 68 during the action of heating surfaces 91 on the preseal die members 92. (Rubber gasket 94 is not shown in FIGS. 6 and 9-11 for clarity but is presumed to be a part of the structure shown in those figures.) The presealing mechanism further includes bushing member 96 with operating shaft 98 disposed therethrough and spring 100 disposed about shaft 98 within bushing member 96 in order to provide an automatic return action for the heat transfer mechanism.

Also at station A, pressure pad 102 operates to fix the seal 113 made by the initial or preseal mechanism. Pressure pad 102 is operated by means of a mechanism similar to that used in providing initial seal 113 and includes shaft 104 mounted in bushing 106, with return action being provided by means of spring 108.

The actions of the initial seal mechanism and the pressure pad mechanism are simultaneous so that at any one time, four pack-ages are processed with two receiving an initial seal (designated by areas 113 in FIG. 4) and two others receiving pressure from the pressure pad to fix the initial seals, all at station A of the head mechanism.

Also, it may be seen clearly in FIGS. 4 and 5 that dies 22 define knife holes 197 for facilitating the action of knives 194 as will be described hereinafter.

Moving to station B, chamber 110 is lowered to cover and finally seal the cheese packages. Thus, a final seal is provided in the areas designated 112 on FIG. 4 at station B to produce a complete seal 113' (FIG. 4). As previously described, the initial seal had accomplished sealing of the areas designated 113 on FIG. 7 at station A. Prior to final sealing at station B a vacuum is drawn within the package chamber defined by the package structure 28 and carbon dioxide with a Freon tracer is introduced therein at station B for purposes of leak detection as will be described hereinafter.

Introduction of the carbon dioxide with freon and final sealing are accomplished after evacuation as shown particularly in FIGS. 6-8 wherein chamber 110 houses apparatus for accomplishing all of such functions. A chamber linkage, generally designated 114 includes a main connector 116, to which arms 118, 120, 122 are rotatably attached by pins 124 or the like. Arm 122 extends to operational connection with pin 47 (see FIG. 1), pin 47 leading to cam follower 54 for operation by cam system 50.

Thus, by motion of such linkage through connector 116, and pin 117 head element 130 operates the chamber mechanism, and the final seal mechanism is operated through shafts 132 and springs 134. Return of head element 130 is accomplished by means of shafts 142 and springs 144. Heating element 136 is provided within hot plates 138 depending from which are heat seal surfaces 140.

A vacuum is drawn from the package chamber with cheese 72 therein along the flow line 149a into channel

149 (FIGS. 6 and 8), and then into conduit 149b (FIG. 6).

Introduction of carbon dioxide with freon is accomplished through conduits 146 into hollow side clamps 74 through conduit connector holes 77 defined by side clamps 74. Referring particularly to FIG. 8, carbon dioxide with freon is introduced in direction 148 through channel 146' into side clamps 74 and then continuing in direction 148 under the top web member 70a by way of tracer inlet holes 75 defined by side clamps 74. Thus, when final seal is accomplished of top and bottom web members 70a, 70b above rubber gasket 94, the cheese package 28 will include not only cheese but also carbon dioxide and freon in an evacuated package chamber. Introduction of such carbon dioxide and freon is further enabled through channels defined by walls 152 under the side clamps 74 (FIG. 7).

Operational connection of chamber 110 with head 24 is provided by a connecting mechanism generally designated 154 on FIG. 3. For instance, return of the chamber 110 is provided by means of spring 156 surrounding shaft 158. Thus, the mechanism of station B provides a complex motion whereby chamber 110 is first lowered to the cheese packages being processed by means of upward motion in direction 49 of pin 47. The motion of pin 47 is transmitted to chamber 110 as a downward motion of connector 116 and a concomitant downward motion of pin 117. Damped motion of the heat seal mechanism is provided through arms 120, 118, and shafts 132 with springs 134. Between the bottoming time for chamber 110 and the bottoming time for the heat seal mechanism the cheese package is evacuated through channel 149 and carbon dioxide and freon are introduced to the cheese package by means of conduits 146 and channel 146'.

Referring to FIG. 12 the evacuation is performed through conduit 149b under control of solenoid 149d by means of package evacuation pump 149c.

The operation at station C, shown on FIG. 3 and FIGS. 9, 10 and 11, is provided by a mechanism which includes station C leak detection chamber member 160. The function at station C is to provide a sequence of motion of the mechanism whereby strippers 174 are first brought down to the cheese packages 28, after which knives 194 partially sever the packages (into groups of two packages each) along cutting areas 195 of FIG. 4 and then chamber 160 is brought down so that a vacuum can be drawn about the cheese packages. Thereby, traces of freon escaping from the packages and a defective seal thereof may be detected.

Referring particularly to FIGS. 9, 10 and 11, the leak detection unit, generally designated 162, includes chamber 160, chamber bushing 164 and a chamber return mechanism including return shafts 170 and return springs 172. The stripper mechanism includes strippers 174 and stripper rods 176, the stripper rods 176 being biased against the package by springs 178. Operation of the chamber is accomplished by arms 180 whose motion pins 182 move in slots 184. Connection to the chamber itself for arms 180 is provided through plates 186 on which is fixedly mounted upstanding lugs 186'. Stripper plate 188 provides the main connection for the stripper mechanism with the main head mechanism and the chamber mechanism.

Vacuum air outlet for the chamber is provided through conduits 190 (FIG. 10) for performing the operation at station D as will hereinafter be described.

As shown in FIG. 3, proximate strippers 174 are pressure pads 192 and stripping knives 194 in order to prevent wrinkling of the webs during the cutting operation, pressure pads 192 being controlled by means of shaft 196 and spring 198. The operation at station C will now be described.

First strippers 174 are brought down to within one-eighth inch from the cheese packages 28. Such spacing is provided in spite of the urging of springs 178 downwardly in the orientation of the drawings of FIG. 9. Such spacing is maintained by the pressure of slots 184 against motion pins 182 as shown in FIG. 9. Arms 180 are pivoted at points 200 and are thereby connected to lugs 186'. Arms 180 are held immovable both by the action of slots 184 and studs 173.

At this point, the head 24 begins to travel downward as shown in FIG. 10 wherein after one-eighth inch of travel, the stripper plates 174 bottom at the cheese package with springs 178 in compression. Then the chamber mechanism 162, arms 180 and studs 173 continue downward another five-eighth inch until the chamber contacts the edge of the dies as shown in FIG. 10. Downward motion of arms 180 is guided by means of slots 184. Thus, it may be seen in FIG. 10 that knives 194 are moved to a position that severs the packages at cutting areas 195 (see FIG. 4) into units of two cheese packages.

Moving to FIG. 11, the head continues to move downward another one-eighth inch thus equalling a total of seven-eighths inch motion from FIGS. 9-11. Motion of the head causes arms 180 to move upward in the center of the drawing of FIG. 11 as guided by slots 184. Such action is produced by the downward motion of studs 173 at the outward extremities of arms 180 and the action of pivots 200. Chamber 160 is immobilized so that springs 172 are in compression. Pivots 200 remain stationary but studs 173 are coming down one-eighth inch thus pressing on arms 180. The motion of arms 180 upwardly at the center of the drawing of FIG. 11 causes upward motion of plates 188 and concomittent upward motion of strippers 174, thus compressing springs 178 to a greater extent than the compression of such springs as shown in FIG. 10.

In sequence therefore, the strippers have started downwardly in FIG. 9 so that knives 194 cut the packages and a chamber is formed about the cheese packages 28 for leak detection. The strippers are then brought up slightly in order to expose the areas 113' of package 28 finally sealed during the operation at station B (see also FIG. 4). Chamber 160 still seals the area around the packages so that a proper vacuum may be drawn through conduits 190 to the leak detection apparatus as will now be described.

Referring to FIG. 12, it may be seen that the chamber 160 is connected by conduit 190 to vacuum pump 210. A vacuum is thereby drawn from the chamber 160 and the evacuated chamber air is drawn to leak detection sensor 212 as shown in FIG. 12. Such leak detection sensors are common in the gas analysis field and include, as an example, a grid or the like with electrodes for detecting the presence of certain electrons. In this case, since freon was introduced with the carbon dioxide into the package, the function of leak detector sensor 212 is to sense the presence of Freon within the air drawn from chamber 160. An electrical signal is thereby transmitted by electrical signal carrying means 214 to leak detector 216 when freon is present in the

air evacuated from chamber 160. It should be stated at this point that while the evacuated air is being drawn through conduit 190, an air compressor source (not shown) is providing compressed air through conduit 218 and valve 221 for insertion to chamber 160, thus to purge the air in chamber 160 and also to purge the sensing unit 212, where a heated cathode-anode platinum element may develop a coating if not oxidized by the purging air from conduit 218.

As stated before, when Freon is detected by the sensing units an electrical signal is sent to leak detector 216 (FIG. 12) which produces an electrical signal for a memory module 222. The action of the memory module is such that a delay is provided prior to the sending of a signal through relay 224 and solenoid 226 to air cylinder 228. The delay is equivalent to the time it takes for a package 28' shown on FIG. 12 to move from station C to station D where final cutting will take place if no signal has been transmitted by the memory module 222 as will be explained hereinafter.

Referring now to FIGS. 2 and 13-15 in connection with the flow diagram of FIG. 12, generally, station D operates firstly to remove the package from conveyor 16 and secondly to selectively cut the tandem units of two packages 28b into individual packages 28. The mechanism of station D includes suction apparatus 250, side clamp release apparatus 252 and cutting apparatus 254. The suction apparatus comprises shafts 256 surrounded by springs 258 and suction cups 260 as well as shaft mounting plates 40a extending from up-rights 40 to slidably mount shafts 256. Furthermore, stop members 256a are fixedly attached to shaft 256 and biased upwardly by springs 258.

The cutting apparatus includes heating element 264, cutting knives 266 and knife carriers 268. Guide 270 is inserted to slot 197 of the package unit in order to properly orient hot knives 266 for the cutting operation at areas 199 of package 28 (FIG. 4). The cutting apparatus is operated by use of air cylinder 228 (shown on FIGS. 12 - 14) cylinder 228 being controlled by solenoid 226.

The side clamp release apparatus, as hereinbefore described includes a plunger 274, which for all packages whether leaking or not, operates to push down on shafts 78 thus releasing side clamps 74 from their hold on the package webs 70. Springs 82 operate to return the side clamps to their normal position for travel in direction 61 (FIG. 1). Thus, side clamps 74 may then be used with other cheese packages 28 in another cycle of operations.

Both the suction apparatus and the cutting apparatus are moved to proximity of the cheese packages 28 on the lower run of the conveyor system by the mechanism shown most clearly in FIGS. 14 and 15. Such proximity mechanism, generally designated 290 includes moving arms 38, 49 connected to plates 40 and 45, respectively, the arms being pivoted at points 294 on the frame member 36 (FIG. 1). Motion of the entire unit is as shown in FIGS. 14 and 15 with the inoperative position being depicted by ghost lines 254' and 40', respectively and the operative position by solid lines in those figures.

Thus, at station C, the suction apparatus is operative once during each cycle as to each cheese package 28. Particular reference to FIG. 15 indicates the withdrawn position of suction cups 260 by means of ghost lines 260'. Thus, the removal mechanism is described as op-

erating by bringing upright 40 to its uppermost position, at which point the suction cups 260 will attach to cheese package units 28 or 28b, as the case may be. Withdrawal of the suction cups 260 to a position depicted by ghost lines 260' will cause the package units 28 or 28b to be deposited upon belts 33 as the suction cups 260 are lowered between such belts 33. On the other hand, depending upon whether or not a signal is received from memory module 222, the cutting apparatus is operative. If no signal is received, the air cylinder receives compressed air from conduits 302 (FIG. 12) through solenoid 226 and a cut is made. Solenoid 226 is controlled by relay 224 and program unit 304.

It may be seen, particularly from FIG. 12, that program unit 304 also operates to control the gas flow through conduit 146 to station B by controlling solenoid 306 and such program unit 304 further operates to control both solenoid 149d through electrical signal means 149e and solenoid 221 through electrical signal means 220, thus controlling the flow of purging air for station C of the operation.

In order to provide a more complete understanding of the present invention, a typical sequence of operations will now be described for a cheese package beginning at station A and flowing through stations B, C, and D for deposit on moving conveyors 308 in FIG. 2. By way of further explanation, it should be understood at the outset of this description that tandem package units, shown in FIG. 2 as units 28b and single units 28 are segregated by the layout of moving conveyors 308; that is, single units 28 flow in directions 30 on either of the moving conveyors 308, but the tandem units 28b will be deposited between moving conveyors 308 into a reject depository.

Generally, the packaging process which may be performed by the above described apparatus involves five station operations: Firstly, an initial operation including forming the package by use of top web member 70a and bottom web member 70b. Bottom web member 70b is formed into a package bottom by overhead pressure and underneath suction so that the bottom web member 70b conforms to the four unit die cavity 68. The upper web member 70a is unformed and lies in a generally flat plane over the cheese which is loaded into the package bottom formed by the bottom web member 70b. Furthermore, the bottom web member is held in place under side clamps 74 for travel throughout the various operation stations as described herein.

Secondly, at station A, an initial seal 113 is provided between the top web member 70a and the bottom web member 70b, so that an appropriate opening is left throughout the transverse central portion of the cheese package 28. Such initial sealing is accomplished by means of a heat seal unit and a pressure pad, which are arranged at the leading edge of a machine head 24 in an apparatus as described herein.

Thirdly, at station B, the inside of the cheese package 28 is evacuated through the spaces left unsealed during the initial sealing process at station A. Immediately thereafter, carbon dioxide gas with approximately one-half per cent Freon tracer is introduced through the same open area of the package 28. The package is then finally and completely heat sealed as a preliminary step to leak detection at the following station C.

Fourthly, at station C, strippers are brought down against cheese package 28 and knives are used to cut the packages into units of two along cut lines 195 as

shown in FIG. 4. Cross cuts 195 are also made at that time partially through the center of cheese package 28 along a line perpendicular to the bisecting cut of the cheese package. Also at station C, a chamber is lowered to seal the ambient area around the finally sealed cheese package 28. A vacuum operates continuously to carry into the vacuum line any trace of carbon dioxide with Freon tracer that might exist in the sealed area. That is, if any Freon has escaped from the sealed package, it may be then sensed by appropriate apparatus as shown in FIG. 12. Prior to the completion of leak detection vacuum, the strippers are raised slightly above the package in order to fully expose all of the seal lines for the package. In this way, since leaks are most likely to occur at or near seal lines, the leak detection sensor is better able to perform its function.

Fifthly and finally, the package is inverted along the lower run 20b of the conveyor system 16 for processing at station D. At this last station, the package 28 undergoes a cutting step, a removal step and a separation step. As background for this step, referring to FIG. 12, there are two possible situations for dealing with package 28 at station D. Firstly, assuming that Freon had been sensed by leak detector sensor 212 at station C, an electrical signal will be transmitted to the leak detector electronics 216 for signaling memory module 222. Memory module 222 then provides a positive signal to solenoid 226 thus inhibiting operation of hot cutting knives 266 to sever the four unit cheese packages along areas 199 (FIG. 4) into four individual cheese packages 28. Such inhibition is provided primarily by means of solenoid 226, after an appropriate delay long enough for package 28' to move from its sensed position at station C to a position at station D. Furthermore, such inhibition of the operation of air cylinder 228 leaves the four unit cheese package in a condition whereby two tandem two package units 28b are presented to the package removal suction apparatus. Particularly, with further reference to FIG. 12, program unit 304 periodically initiates a closing of relay 224, thus periodically enabling transmission of a signal from memory module 222. When there is a signal from memory module 222 (a leak was detected at station C and delay time has passed), the signal will be transmitted to solenoid 226, thus activating the solenoid and thereby closing the flow of compressed air through conduit 302. In this way, no air reaches air cylinder 228 and, since air cylinder 228 activates the hot cutters, a cutting operation to provide individual, as distinguished from tandem, packages will not take place. It should be understood that associated with memory module 222 is a means for delaying the transmission of a signal by components well known in the art such as shift register means and the like.

On the other hand, if the leak detection sensor 212 does not sense freon, no electrical signal is propagated to solenoid 226. Thus, cutting by knives 266 will not be inhibited and four individual packages will be provided for the removal suction apparatus.

In either event, suction apparatus 250 cyclically provides suction contact between suction cups 260 and four inverted cheese package units 28 or 28b. Periodic contact as recited above is provided primarily for suction cups 260 by means of the cam-activated motion of arms 38.

Removal of the various packages 28 and 28b deposits four packages onto belts 33, which move the packages

onto moving conveyors 308. Individual packages 28 are then carried in directions 30. Tandem packages 28b, however, are too wide for moving conveyors 308 and are thereby deposited between such conveyors as shown in FIG. 2.

Thus, in accordance with the above description of an apparatus and method, a fully automatic, continuous packaging, preserving, leak detection and sorting system is used to overcome difficulties heretofore experienced in the food processing industry. Four or more packages are processed at any one time by motion of such packages through a series of processing stations.

What is claimed is:

1. An apparatus for vacuum packaging at a plurality of operation stations comprising a first operation station, a second operation station, a third operation station, and a fourth operation station, said first operation station including means for forming a package structure having a package bottom and a package top in general contact with each other to define a package chamber and first and second areas of contact, and means for partially sealing said package bottom to said package top in said first area of contact therebetween, said second operation station including means for evacuating said package chamber having a chamber unit overlying said package structure, means for introducing a leak tracer substance to said package chamber, and a final seal unit within said chamber unit, such that a leak tracer substance is introduced to said package through a chamber opening defined by said second area of contact whereby, at said third operation station, leak detection for such package structure is accomplished by sensing said leak tracer substance in the proximity of said package structure after final sealing is provided for said second area of contact by said final seal unit of said second operation station, said third operation station further including means for partially cutting said package structure in a transverse direction before leak detection, a leak detection chamber unit defining a leak detection chamber within which said finally sealed package structure is placed, conduit means connected to said chamber, vacuum means operatively connected to said conduit means, compressed air means operatively connected to said conduit means, control means for operating said compressed air means such that said leak detection chamber is evacuated by said vacuum means to detect the presence or absence of tracer substance within said leak detection chamber and said chamber is purged by said compressed air means after said evacuation, said fourth operation station including means for selectively cutting said finally sealed package structure completely in said transverse direction depending upon said detection of the absence of tracer substance within said leak detection chamber, means for transmitting information of said detection from said leak detection chamber to said means for cutting completely, and removing means for removing packaging units from said means for forming.

2. The invention according to claim 1 wherein said means of transmitting includes a leak detection sensor, leak detection electronics, a memory module, a solenoid means and an air cylinder for operating said means for cutting completely, such that said leak detection sensor detects the presence of tracer substance to provide an electrical signal to said leak detector electronics, which in turn provides a signal for said memory module, said memory module providing a delay for said signal equivalent to the time necessary for said sealed package structure to move from said third operation station to said fourth operation station, after which said memory module controls said solenoid means to inhibit operation of said air cylinder.

3. A method for vacuum packaging of perishable items during a plurality of station operations comprising the steps of:

a. In a preliminary station:

1. forming a plurality of package bottom members;
2. depositing perishable items into said bottom members; and,
- overlying said items with a plurality of package top members thus to form packages;

b. In a first station:

1. partially sealing said members to each other leaving openings therebetween;

c. In a second station:

1. evacuating the space defined between said partially sealed members;
2. introducing to said space a tracer substance; and,
3. thereafter completely sealing said members to each other;

d. In a third station:

1. partially cutting said members in a transverse direction and completely cutting said members in a longitudinal direction to form tandem package units of two packages each;
2. enclosing tandem package units in a leak detection chamber;
3. evacuating said chamber; and
4. sensing the presence or absence of tracer substance in said chamber to detect leaking of said units;

e. In a fourth station:

1. selectively cutting said members to completely cut said members in a transverse direction, said selection depending upon the presence or absence of said tracer substance; and
2. depositing said packages onto a conveyor unit for further processing of those packages for which the absence of tracer was sensed.

4. a method according to claim 3 including the step of transmitting information containing the sensed presence or absence of tracer substance to a means of controlling said fourth station cutting step.

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